

We claim:

1. A method for solution mining nahcolite, capable of extracting nahcolite from geological formations containing deposits of lean nahcolitic oil shale as well as beds of essentially pure nahcolite, comprising:

establishing at least one well;

injecting hot aqueous liquid via the well into a mining zone within the formation, so that the hot aqueous liquid has a temperature of at least 250°F in the mining zone and is maintained at a sufficiently high pressure to prevent flashing of carbon dioxide and water vapor.,

dissolving nahcolite in the hot aqueous liquid to form a production solution comprising water and sodium bicarbonate; and

recovering the production solution from the mining zone through a well.

2. The method of Claim 1 wherein the hot aqueous liquid is a member of the group consisting of water and an aqueous solution comprising sodium bicarbonate.

3. The method of Claim 2 wherein the hot aqueous liquid being injected into the well includes recycled production solution from which some of the sodium bicarbonate has been recovered.

4. The method of Claim 2 wherein the hot aqueous liquid being injected contains up to 10% sodium bicarbonate

5. The method of Claim 2 wherein the hot aqueous liquid being injected into the well contains less than 5% sodium bicarbonate.

6. The method of Claim 3 wherein the hot aqueous liquid being injected into the well contains less than 10 % sodium carbonate.

7. The method of Claim 3 wherein the hot aqueous liquid being injected into the well contains less than 5.5 % sodium carbonate.

8. The method of Claim 2 wherein the injection of the hot aqueous liquid causes the fracturing of the nahcolitic oil shale, and the rate at which the fracturing occurs is controlled by a combination of the rate of injection of the hot aqueous liquid and the temperature of the aqueous liquid.

9. The method of Claim 8 wherein the temperature of the aqueous liquid is between 250°F and the equilibrium temperature corresponding to the minimum hydraulic fracture pressure of the nahcolitic oil shale deposit.

10. The method of Claim 1 wherein the pressure is less than the minimum hydraulic fracture pressure of the nahcolite deposit being mined.

PATENT APPLICATION
Attorney Docket No. 40217.0001USC1

11. The method of Claim 10 wherein the pressure is maintained by injecting a pressurized inert gas as cap above the mining zone.

12. The method of Claim 11 wherein the inert gas is selected from the group consisting of nitrogen, helium, hydrogen, methane, and carbon dioxide.

13. The method of Claim 10 wherein the pressure is controlled by regulating the flow rate of injecting the hot aqueous liquid and the flow rate of recovering the production solution.

14. The method of Claim 1 wherein the solution mining is carried out in a lean nahcolitic oil shale interval.

15. The method of Claim 1 wherein the solution mining is carried out in beds of essentially pure nahcolite.

16. The method of Claim 2 wherein the production solution is recovered at a temperature between 250°F and 550°F.

17. The method of Claim 2 wherein the production solution is recovered at a temperature between 270°F and 400°F.

PATENT APPLICATION
Attorney Docket No. 40217.0001USC1

18. The method of Claim 2 wherein the production solution contains between 12 and 70% sodium bicarbonate.

19. The method of Claim 2 wherein the production solution contains between 15 and 47% sodium bicarbonate.

20. The method of Claim 2 wherein the production solution contains between 20 and 35% sodium bicarbonate.

21. The method of Claim 2 wherein the production solution is recovered at a pressure between 30 psig and 700 psig.

22. The method of Claim 2 wherein the production solution is recovered at a pressure between 150 psig and 700 psig.

23. The method of Claim 2 wherein the production solution is recovered at a pressure between 200 psig and 550 psig.

24. The method of Claim 2 wherein the well comprises at least two pipe strings and the injecting of the hot aqueous liquid and the recovering of the production solution occur in the same well.

PATENT APPLICATION
Attorney Docket No. 40217.0001USC1

25. The method of Claim 24 wherein the injecting of the hot aqueous liquid occurs at an elevation in the mining zone above the elevation in the mining zone where the recovering of the production solution occurs.

26. The method of Claim 24 wherein the injecting of the hot aqueous liquid occurs at an elevation in the mining zone below the elevation in the mining zone where the recovering of the production solution occurs.

27. The method of Claim 24 wherein the injecting of the hot aqueous liquid and the recovering of the production solution are alternated periodically.

28. The method of Claim 11 wherein the well comprises at least three piping strings and the injecting of the hot aqueous liquid, the injection of the inert gas, and the recovering of the production solution all occur in the same well.

29. The method of Claim 28 wherein the well is comprised of at least three concentric piping strings.

30. The method of Claim 29 wherein the injecting of the hot aqueous liquid occurs in an inner piping string, the recovering of the production solution occurs in an outer concentric area between concentric piping strings and the injecting of inert gas occurs in an area between concentric piping strings intermediate of the piping string carrying the hot aqueous liquid and the area carrying the production solution.

PATENT APPLICATION
Attorney Docket No. 40217.0001USC1

31. The method of Claim 11 where the injecting of the hot aqueous liquid occurs in a first piping string, the recovering of the production solution occurs in a second piping string, and first and second piping strings are contained in the same casing.

32. The method of Claim 2 wherein the injecting of the hot aqueous liquid and the recovering of the production solution occur in different wells.

33. The method of Claim 2 wherein the recovered production solution is essentially clear, is free of solids and organics and contains minimal amount of salt.